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## Today's Topics:

## modifications for Kenwood th-X5at handhelds

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From: tank!cps3xx!usenet@handies.ucar.edu (Usenet file owner)  
Subject: modifications for Kenwood th-X5at handhelds  
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In the past, I posted some mods for the Kenwood TH-X5AT series of HTs. My previous posting had some minor errors, and left some questions unanswered. Yesterday, I helped a friend modify his TH-45AT, and some of these questions were answered. This posting will clear up the problems in the previous posting, as well as contain all of the important information from the previous posting. You may delete your previous copy of this information, and replace it with this one.

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Here are some mods for the TH-25AT and the TH-45AT. Please note that I do not encourage transmitting on a frequency for which you do not have a license, nor do I encourage transmitting in the United States on a non-amateur frequency with equipment that has not been FCC type accepted. This is illegal in the United States, even if you have a license to transmit on the given non-amateur frequency.

First let me recommend that you buy the service manuals for these radios. The service manual is not expensive (about \$15 I think) and it will greatly help you in performing these mods.

Before performing any of these modifications, make sure you know what's in your memories, because they will be lost.

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Look at the schematic for your radio. In the lower left hand corner is an IC labeled IC2. This is an ASIC microprocessor. At the lower right hand corner of this uP are several diodes and pull-up or pull-down resistors. They are D4, D3, R19, R18, R28, R20, R21, R22, R25, R26, and a couple of resistors that are not even on the schematic that attach to B2 (pin 51 on IC2) and B3 (pin 50 on IC2). The TH-45AT schematic shows R23 on the ASIC uP pin B2. Another important resistor is R27; on the schematic it is located next to the frequency selection switch EN1 above IC2. A less important resistor (for modification purposes) is R36; on the schematic it is located to the right of IC2 in line with the top edge of IC2.

The schematic for the TH-25AT shows:

		R18-R21	R25	R26,27	R28	R36
TH-25A	M,M2	-12	0	X	X	X
TH-25A	M3,M4,X	-23	0	X	X	X
TH-25AT	K	-11	0	0	X	X
TH-25AT	M,M2	-12	0	X	X	X
TH-25E	T	-52	X	X	0	0
TH-25E	W	-62	X	0	0	0

And the schematic for the TH-45AT shows:

		R19-R21	R22	R23	R25	R26,27	R28	R36
TH-45A	M1,M2,X	-21	0	0	X	X	0	X
TH-45A	M3,M4	-22	0	X	0	X	X	X
TH-45AT	K	-10	0	X	0	X	X	0
TH-45AT	M1,M2	-21	0	0	X	X	0	X
TH-45AT	M3,M4	-22	0	X	0	X	X	X
TH-45E	T	-51	X	0	X	X	0	X
TH-45E	W	-61	X	0	X	0	0	0

where 0 means USED, and X means NOT USED.

Some of the above codes are:

K USA

T England

X      Australia  
M      Other Areas

These components are found on the flexible circuit board under the display. To get to them, take the radio apart.

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- (1) Only 8 screws must be removed from the case to take the radio apart; these are the 4 screws that hold the battery clip on, the 2 screws on the back half of the case near the PTT switch, the screw on the back of the case under (and in line with) the BNC connector, and the screw on the back half of the case adjacent to the external speaker jack.
- (2) After removing these 8 screws, remove the front half of the case from the back half. You may unconnect the blue plug from the touch tone circuitry on the front half of the case to make further work on the radio more convenient, but it is not necessary.
- (3) Place the radio back side down with the antenna away from you. Now, unsolder the two grounding wires from the plate which covers much of the radio's circuitry. These wires are near the top of the plate and will be quite obvious.
- (4) Next, remove the 7 screws that hold this plate on. 5 of the screws for this plate are up on top and are quite obvious; the other 2 are at the bottom of the plate, and may be hidden by your CTCSS unit. Remove the plate.
- (5) Remove the red plug with about 7 wires that connects just under the volume and squelch switch.
- (6) Remove the screw that holds the PTT/LAMP/MONI switch assembly; this screw is on the left side of the radio just under the PTT switch.
- (7) Remove the two screws that hold the top assembly to the back case of the radio; these two screws are on either side of the orange flexible circuit board coming from the top assembly and plugging into the back case of the radio. You may need to use a screwdriver or stick to move the orange flexible circuit board out of the way in order to see these final two screws.
- (8) Unplug the orange flexible circuit board from the back case. At this point, the whole top assembly should come free quite easily. The BNC connector will stay attached to the back case, and the whole top assembly will come up over it.

(9) Unfold the flexible circuit board and unfold it so that the components are accesable. One of the fold-out parts of the flexible board will look something like this: (the component side is shown up)

```
+-----+
| R R R R D3 R R |
| 2 2 2 2    7 2 | The 0's are very large solder pads.
| 5 4 3 2      1 |
|                 |
| R  0      0 R20| Not all components will be installed on your
| 2 0      0 R19| circuit board.
| 6 0      0 R18|
| 0      0 R28|
|                 | D3 & D4 are two diodes in a three terminal
|                 R | package. The anodes of the diodes are in
|                 D4 6 | common.
+-----+
|                 |
|                 |
```

The fold out board is actually square, but with only characters for graphics, I couldn't draw it that way. It comes out reasonably square on a printer with 10 characters/inch and 6 lines/inch.

On both radios, R27 is located to the right of the four blue buttons on the back of the radio (M CTCSS SHIFT REV). You should be able to see this on the back of the now removed top assembly.

On both radios, R36 is for the European tone burst to "whistle up" repeaters. R36 is located on another portion of the flexible circuit board, closest to pin 1 of IC2. IC2 is the IC closest to the portion of the flexible circuit board shown above. Most users will not want to change R36.

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Here is the function of the diodes and pull up or pull down resistors (for both the TH-25AT and the TH-45AT unless otherwise specified):

D4 selects the display type.  
installed: channel display  
removed: normal frequency display

You probably don't want to install this.

R6 is the pullup resistor for D4. Do not remove it, so that

if D4 is removed, pin 44 of IC2 will be properly pulled up.

D3 selects VHF or UHF.

installed: VHF

removed: UHF

You definitely don't want to change this!

R7 is the pullup resistor for D3. Do not remove it, so that if D3 is removed, pin 45 of IC2 will be properly pulled up.

R25 selects automatic offset selection.

installed: automatic offset selection enabled.

removed: automatic offset selection disabled.

R25 seems to have no effect on the TH-45AT.

R23,27 frequency selection step size.

Frequency selection step sizes is only known for TH-45AT.

R23 R27 frequency selection step sizes:

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out out 5 and 10 kHz

in out 5 and 25 kHz (TH-45AT default)

out in 5 and 12.5 kHz (author's preference)

in in 10 and 20 kHz

R23 probably has no effect on the TH-25AT. I never checked. I was quite satisfied with the 5 and 10 kHz step sizes for the TH-25AT. I never tried changing R27 to see what would happen.

R24 ? something with the CTCSS tone ?

installed: When a TX offset is selected, the CTCSS tone is always transmitted. The TONE button does not work correctly. When the TONE button is depressed, the display goes to 430.000 c, and nothing seems to work. (A "c" is displayed in the channel number position.) The action of the TH-25AT is unknown.

removed: CTCSS tone selection works correctly. Both the TH-25AT and the TH-45AT are delivered this way.

You probably don't want to install this.

R19 function unknown.

R19 is not installed in the European version.

R20 function unknown.

R20 is not installed in the European version.

R21 function unknown.

R21 is not installed in the European version.

R19, R20, and R21 are all in parallel. Thus, if any of them is installed, it is like all of them are installed.

R26 function unknown.

R26 is installed in the European version.

On the TH-25AT:

R22,28 select RX and TX frequency range.

R22	R28	RX range	TX range
---	---	---	---
in	out	144-148	141-163 (USA default)
in	in	144-148	144-148
out	out	100-200	100-200 (only where your PLL locks up.)
out	in	142-151	???-???

R18 exact function unknown.

installed: as delivered in USA.

removed: TX disabled from 146-148.

The RX and TX frequency range based on R22 and R28 are unknown if R18 is removed.

On the TH-45AT:

R18,28 select RX and TX frequency range.

R18	R28	RX range	TX range
---	---	---	---
in	out	440-450	440-450
in	in	438-450	438-450 (USA default)
out	out	200-500	200-500 (only where your PLL locks up.)
out	in	215-230	215-230? (PLL won't lock up.)

R22 TX offset selection

installed: 1.6 MHz offset (perhaps for 220, or Europe)  
removed: 5 MHz offset (USA default)

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PLL adjustment

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I have found a quick and easy way to retune your PLL (in the TH45-AT) with a minimum of test equipment. All you need is a scope and a small tuning tool. First, take off the battery pack holder plate. Then, remove the silvery sticker covering the tuning pot access holes. If the radio is positioned on its back, with the top folded over so that the touch tone pad is also facing down, the test point you want (TP1) is on the bottom half of the radio, near the center (left to right), and close to the battery; the tuning pot you want (TC1) is on the bottom, and closest to the PTT switch. Under no circumstances change the tuning of TC51. This is used to calibrate the output of the radio with the display the radio is giving; you don't want to mess with it. Once again, the Service Manual makes it very clear where these points are, if you are having trouble with my descriptions. On with retuning the PLL. With the radio on, and receiving, monitor the voltage and the waveform on test point TC1. Tune the radio DOWNWARDS in frequency until the PLL unlocks. Note that the radio will beep when this happens, and the waveform on TP1 will change. Tune the radio about 1 MHz higher so that the PLL locks up again, and note the voltage on the testpoint, TP1. Now, tune the radio to the LOWEST frequency that you want to be able to receive. (Be very careful when you adjust TC1. If you are not careful, you could break TC1 loose. This will cause your radio to have microphonics. Mechanical vibrations will change the value of this capacitor, and thus change the tuning on the PLL. If you encounter this problem, you can repair it by dripping wax through the small hole onto TC1, or by replacing TC1. It is of course better not to break it in the first place.) Adjust TC1 until the voltage on the test point TP1 is the same as what was noted earlier. Button the radio back up, and you're done. You will not be able to tune the PLL to any range you want. There are limits. On my radio, I have been able to retune the radio so that I can receive from 439.2-468.6 MHz with a set of batteries fresh out of the charger. The tuning range will probably diminish as the battery voltage decreases. I have not retuned the PLL on my 2m HT, but I'd imagine the same technique will prove fruitful.

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are found here, I am responsible.  
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